Submerged Aquatic Vegetation in Currituck Sound, North Carolina and Back Bay, Virginia

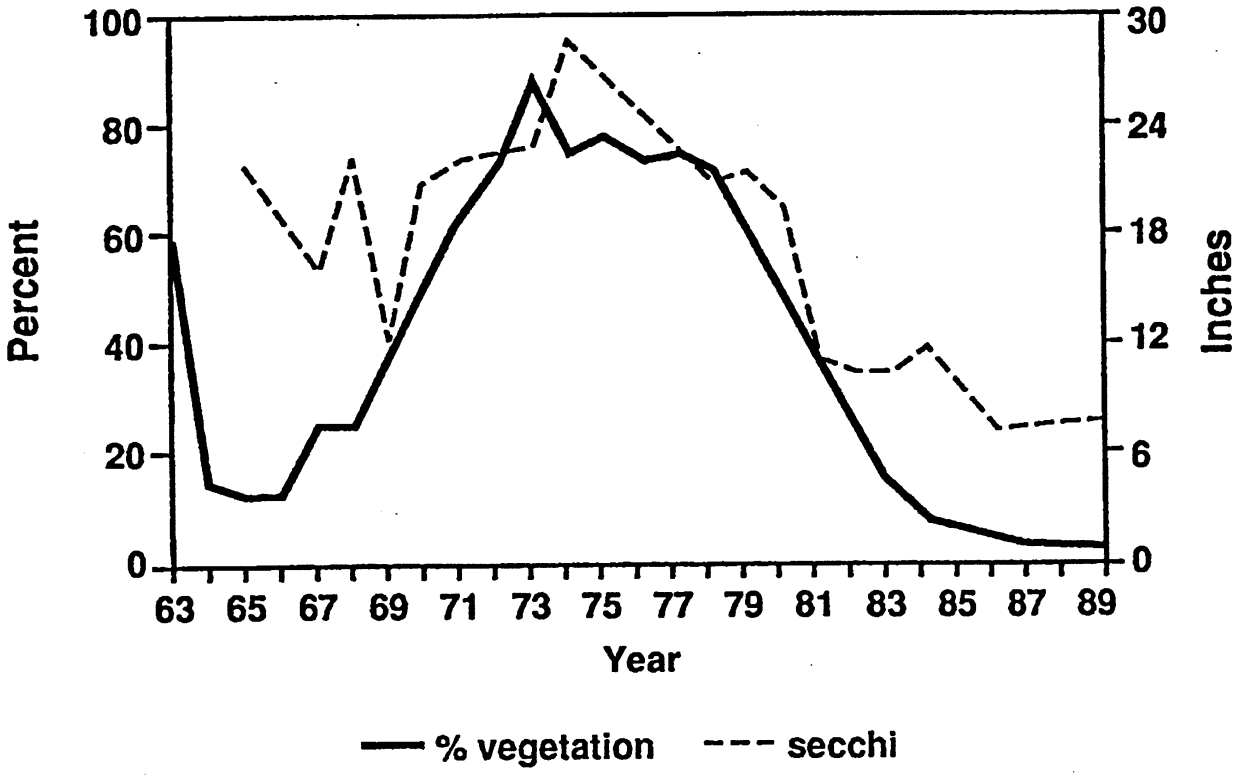
Habitat Mapping Using Aerial Photography and Change Analysis Using Transect Surveys

Abundance of submerged aquatic vegetation has undergone several long-term downward trends since early 1900's and has not fully recovered to former abundant conditions of the past century."

Morton and Kane 1994

- USGS - Carter and Rybicki 1991- TSS explained 85.1% variation in light extinction coefficient
- VA State Water Control Board – Alden and Priest 1991 – organic-rich suspended particles plant detritus and sediments
- NCDWQ – NCDEHNR 1990 – 1989 Synoptic Survey – higher turbidity, suspended solids and lower secchi depths, also phosphorous limited system
- NCDWQ – 1992/1993 ORW Evaluation Study – turbidity 45-50 NTU and suspended solids 73-85 mg/l
  - Macroinvertebrates – presence of SAV support diverse community
  - Biotic index higher than any other oligohaline system and comparable to highest biotic index values in the state

Back Bay
Water Clarity and SAV Abundance



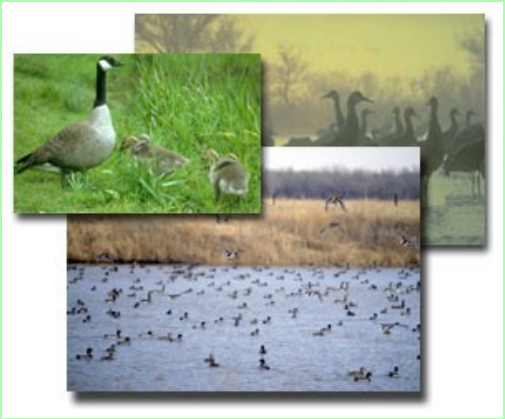
Norman and Southwick VDGIF 1990

SAV Cooperative Habitat Mapping Project

- Monitor and map distribution and abundance of SAV in North Carolina and southeastern Virginia's estuaries

- Gather historical information on SAV distribution and abundance to provide reference baseline for SAV restoration

- Restore SAV to areas where occurred historically



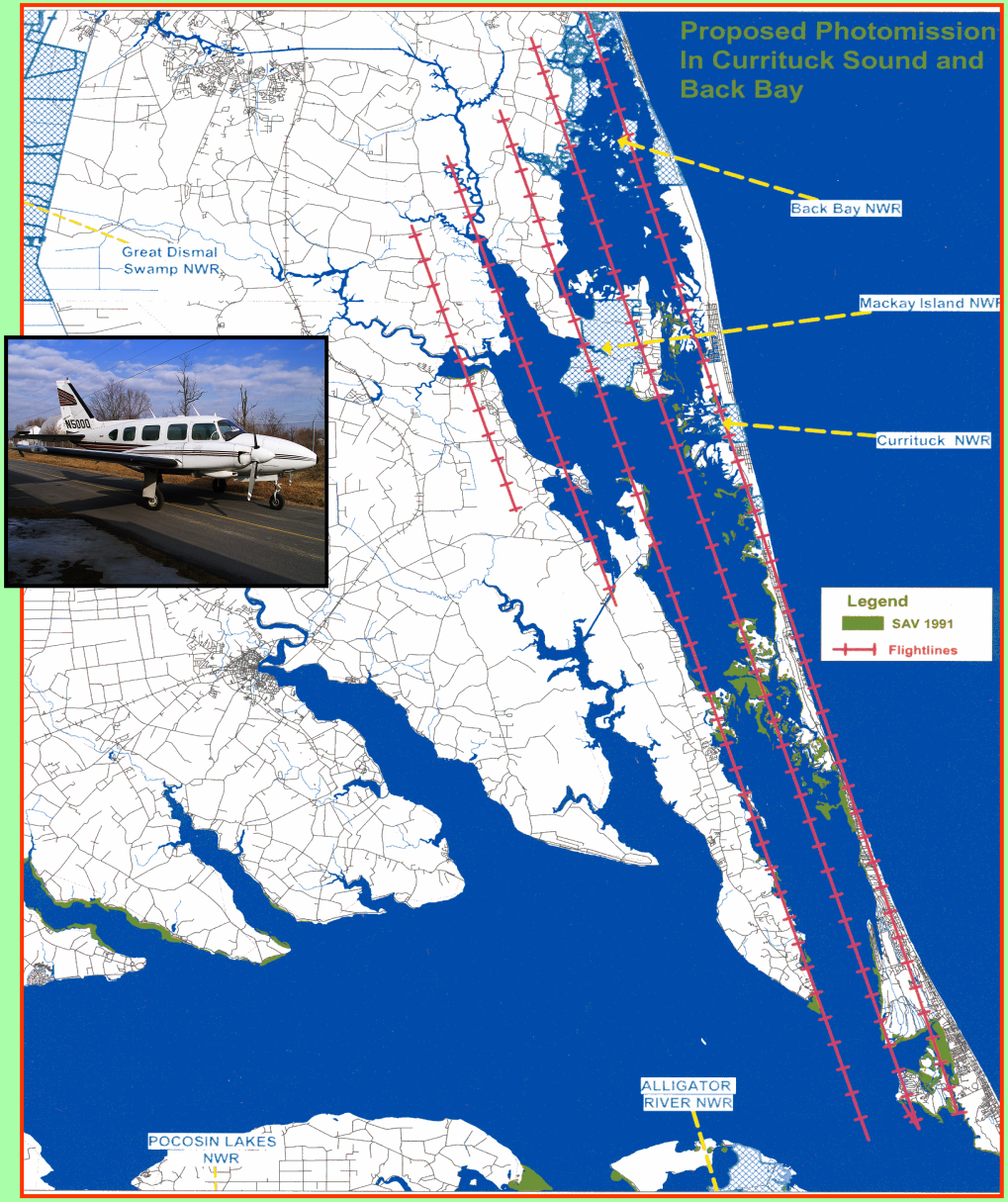
SAV Habitat Cooperative Mapping Project at Elizabeth City State University

- **Photo rectification and interpretation**
  - Trimble GeoXT and ArcGIS Image Analysis and Spatial Analy
  - Maintain data integrity allowing for survey replication

- **Field surveys**
  - Water clarity sampling, temperature, salinity, DO, pH
  - Distribution, density and species composition of SAV
  - Signature development and spatial accuracy assessme

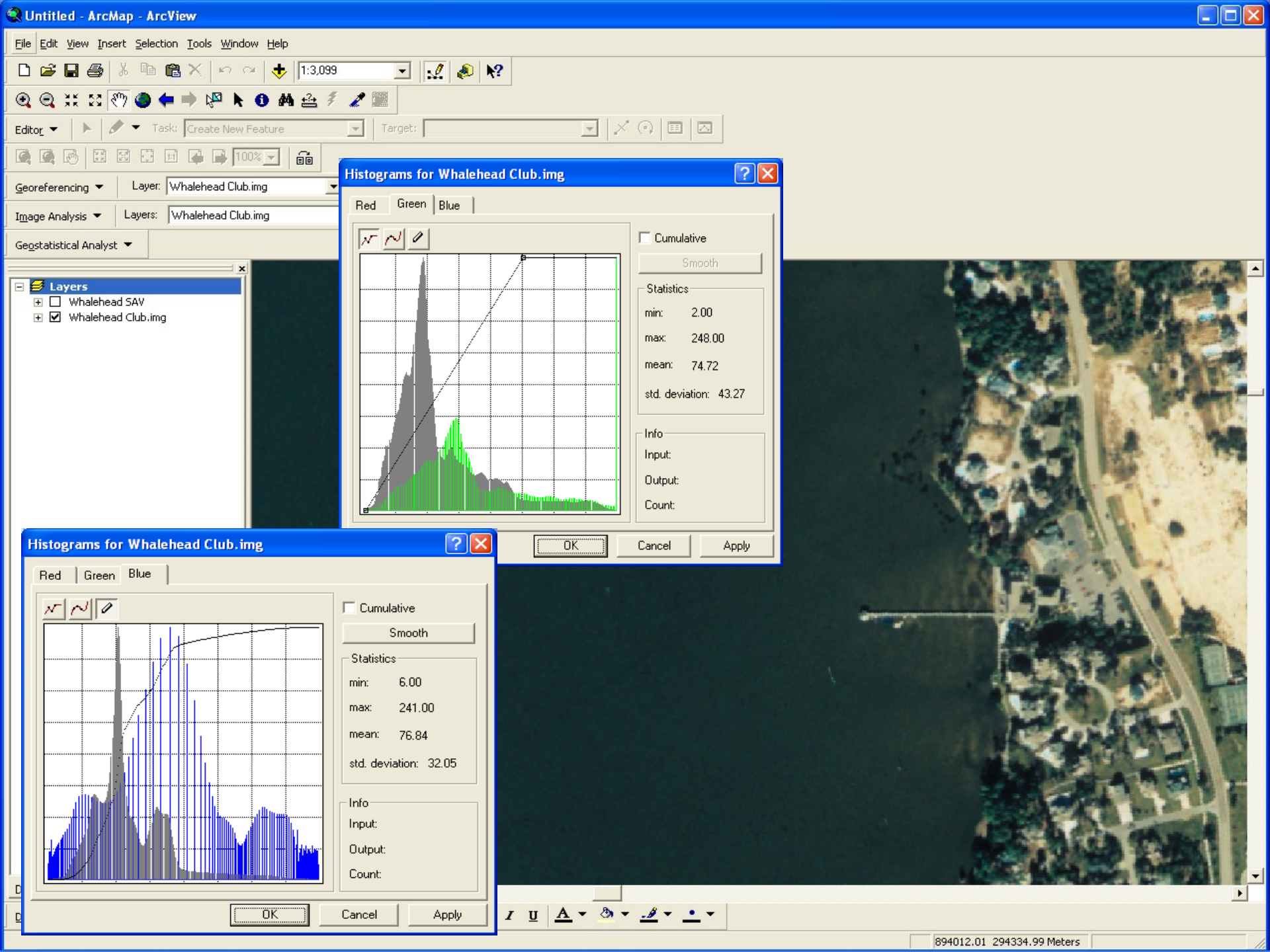
- **Comparative analyses**
  - Historical database - Ferguson and Wood (1991)
  - Refuge staff and local knowledge
- **GIS database development**
  - Digitize polygons
  - Map production

Aerial Photography



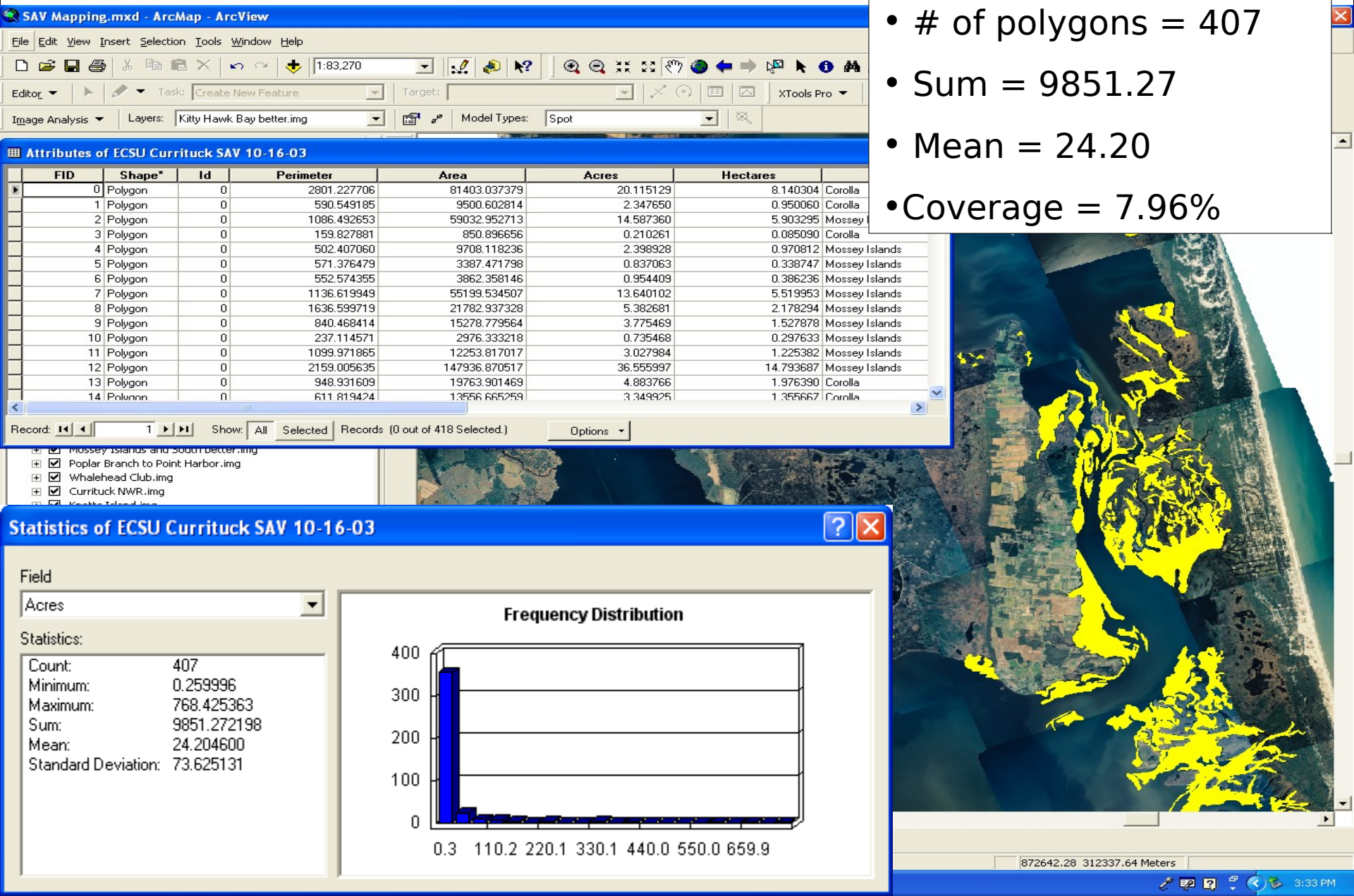
- October 16, 2003 – between 10:34-11:42 AM
- Five flight lines, 153 exposures, formal tilting
- Negative color vertical aerial photography
- 12,000’ AMT
- 1” – 2000’ negative scale; 1:24000
- Overlap - 60% forward, 30% side
- Color film diapositives (10” x10”)
- Criteria - Orth et al. and Finkbeiner (2001)

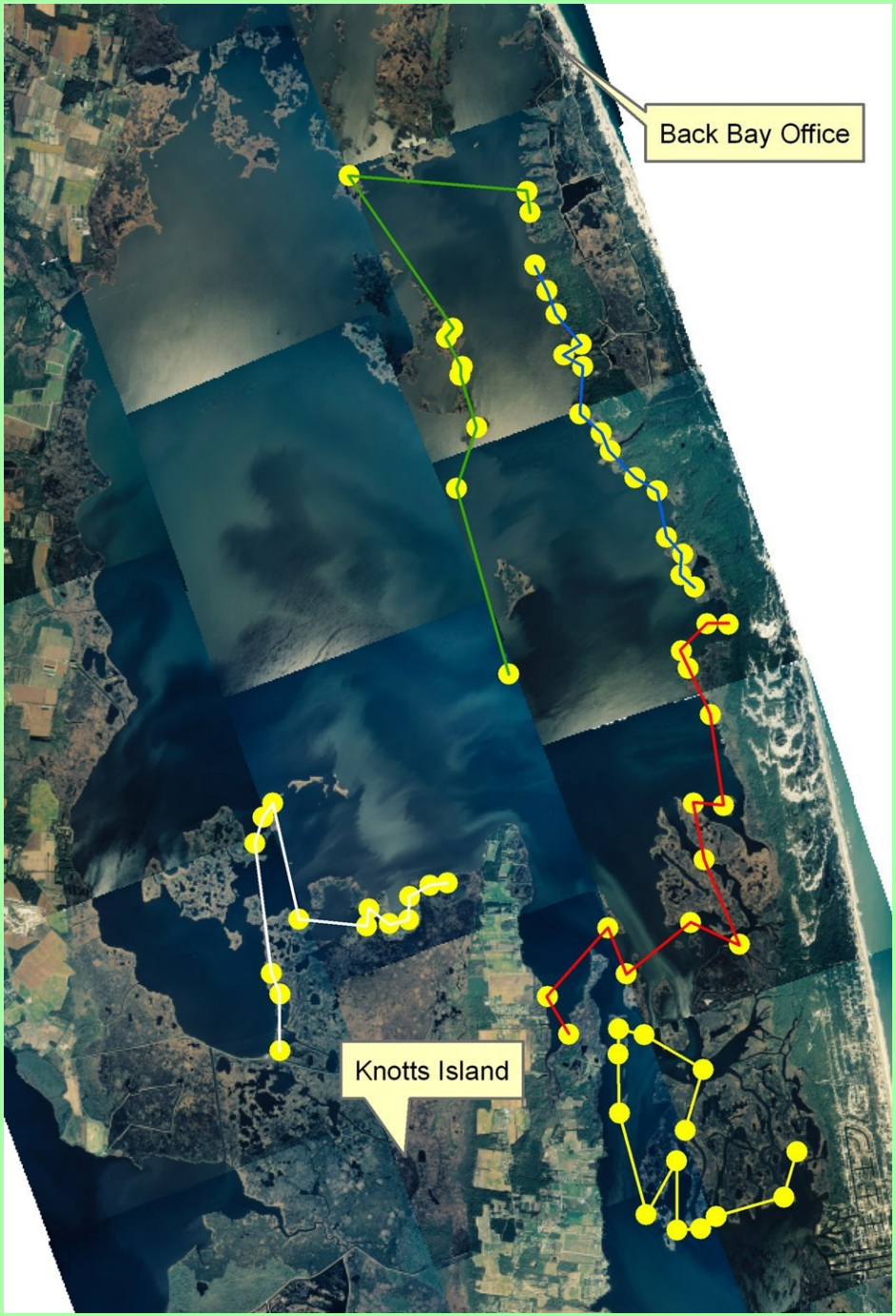
CS/KHB
10-16-03
1"=2000'
4-18
Possible SAV beds
Sanders Bay and Mossey Island

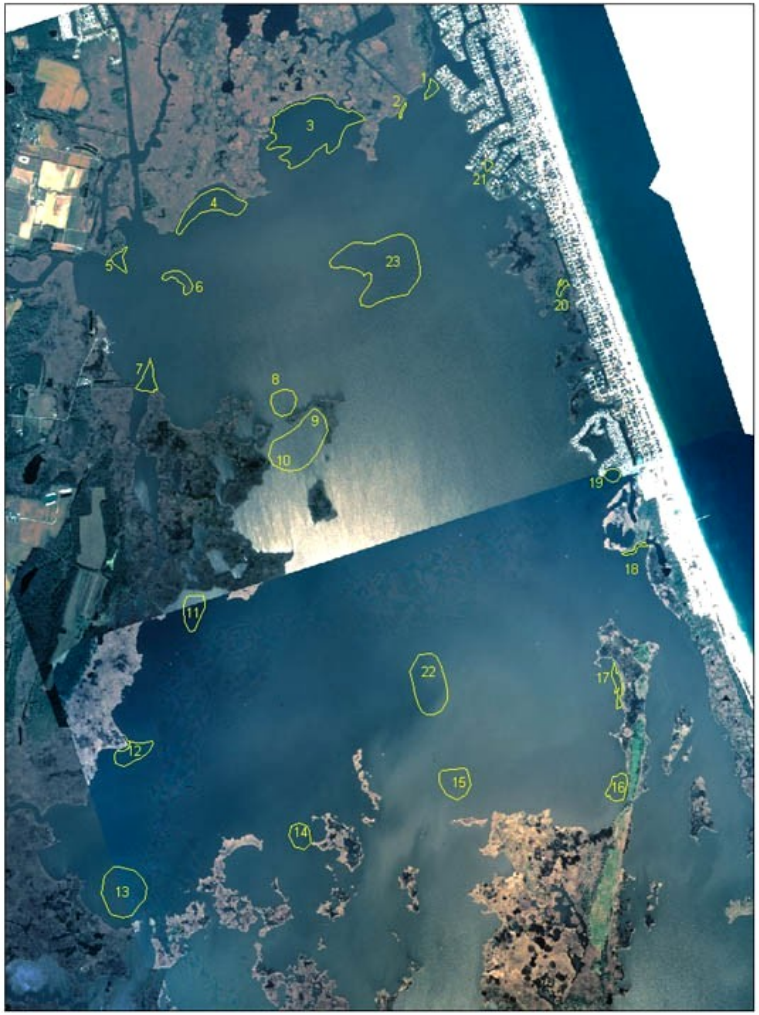

Untitled - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
1:3,099
Editor
Task: Create New Feature
Target:
Georeferencing
Layer: Whalehead Club.img
Image Analysis
Layers: Whalehead Club.img
Geostatistical Analyst
Layers
Whalehead SAV
Whalehead Club.img
Histograms for Whalehead Club.img
Red
Green
Blue
Cumulative
Smooth
Statistics
min: 2.00
max: 248.00
mean: 74.72
std. deviation: 43.27
Info
Input:
Output:
Count:
OK
Cancel
Apply
Histograms for Whalehead Club.img
Red
Green
Blue
Cumulative
Smooth
Statistics
min: 6.00
max: 241.00
mean: 76.84
std. deviation: 32.05
Info
Input:
Output:
Count:
OK
Cancel
Apply
894012.01 294334.99 Meters

Total Acreage of the Study Area

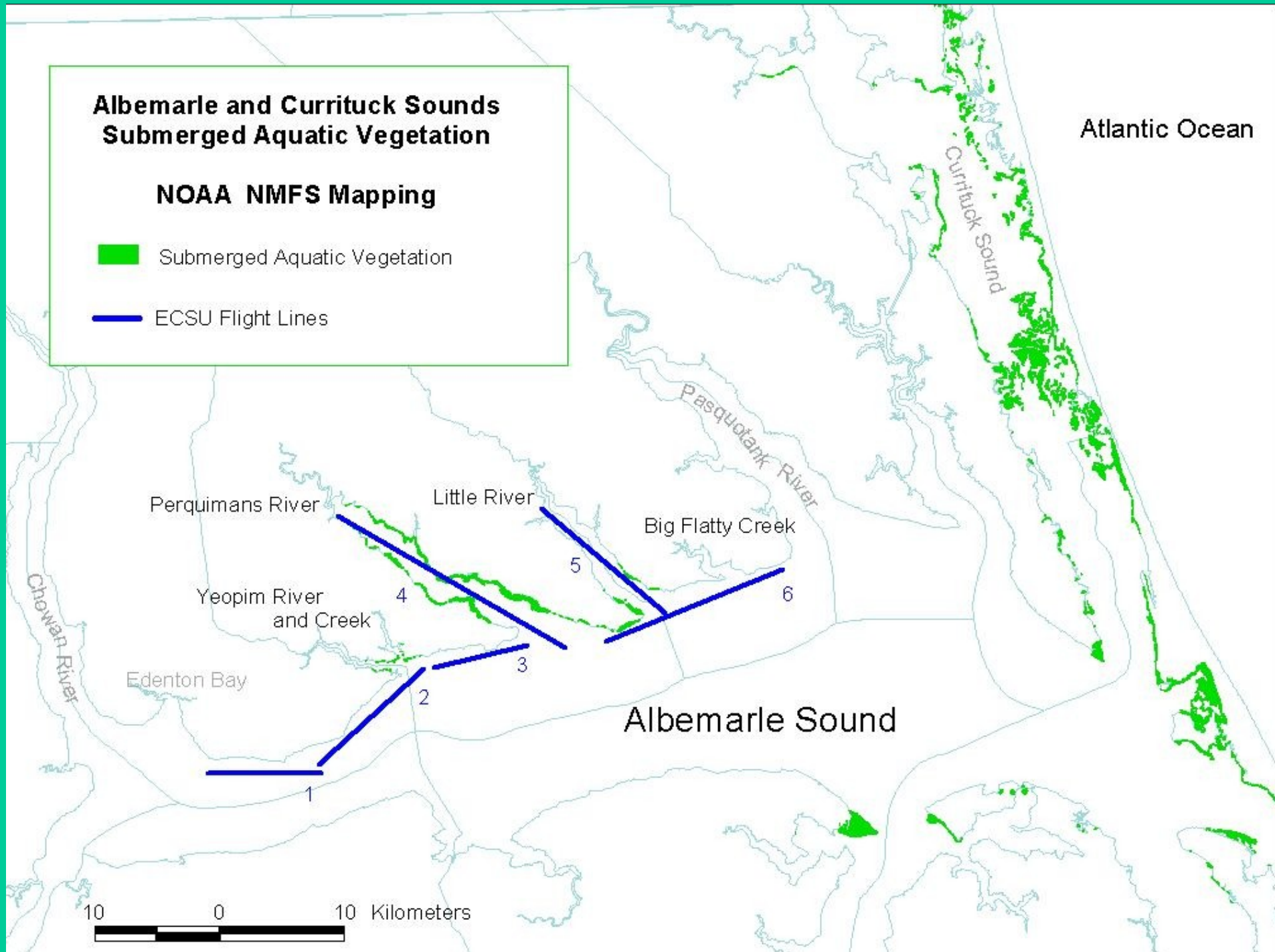
- # of polygons = 407
- Sum = 9851.27
- Mean = 24.20
- Coverage = 7.96%


SAV Mapping.mxd - ArcMap - ArcView
File Edit View Insert Selection Tools Window Help
1:83,270
Editor Task: Create New Feature Target: XTools Pro
Image Analysis Layers: Kitty Hawk Bay better.img Model Types: Spot
Attributes of ECSU Currituck SAV 10-16-03
FID Shape* Id Perimeter Area Acres Hectares
0 Polygon 0 2801.227706 81403.037379 20.115129 8.140304 Corolla
1 Polygon 0 590.549185 9500.602814 2.347650 0.950060 Corolla
2 Polygon 0 1086.492653 59032.952713 14.587360 5.903295 Mossey
3 Polygon 0 159.827881 850.896656 0.210261 0.085090 Corolla
4 Polygon 0 502.407060 9708.118236 2.398928 0.970812 Mossey Islands
5 Polygon 0 571.376479 3387.471798 0.837063 0.338747 Mossey Islands
6 Polygon 0 552.574355 3862.358146 0.954409 0.386236 Mossey Islands
7 Polygon 0 1136.619949 55199.534507 13.640102 5.519953 Mossey Islands
8 Polygon 0 1636.599719 21782.937328 5.382681 2.178294 Mossey Islands
9 Polygon 0 840.468414 15278.779564 3.775469 1.527878 Mossey Islands
10 Polygon 0 237.114571 2976.333218 0.735468 0.297633 Mossey Islands
11 Polygon 0 1099.971865 12253.817017 3.027984 1.225382 Mossey Islands
12 Polygon 0 2159.005635 147936.870517 36.555997 14.793687 Mossey Islands
13 Polygon 0 948.931609 19763.901469 4.883766 1.976390 Corolla
14 Polygon 0 611.819424 13556.665259 3.349925 1.355667 Corolla
Record: 1 Show: All Selected Records (0 out of 418 Selected.) Options
Poplar Branch to Point Harbor.img
Whalehead Club.img
Currituck NWR.img
Statistics of ECSU Currituck SAV 10-16-03
Field
Acres
Statistics:
Count: 407
Minimum: 0.259996
Maximum: 768.425363
Sum: 9851.272198
Mean: 24.204600
Standard Deviation: 73.625131
Frequency Distribution
400
300
200
100
0
0.3 110.2 220.1 330.1 440.0 550.0 659.9
872642.28 312337.64 Meters
3:33 PM





Five routes were planned for the SAV Hunt (**left**). The Back Bay Restoration Foundation, Back Bay National Wildlife Refuge staff, and volunteers were able to collect valuable data that helped us digitize accurate polygons. On a separate previous occasion, boats were sent to polygons in northern regions of the Bay to collect similar data (**above**). All of the data collected was used to create a picture of SAV in Back Bay.


Albemarle and Currituck Sounds
Submerged Aquatic Vegetation
NOAA NMFS Mapping
Submerged Aquatic Vegetation
ECSU Flight Lines
Atlantic Ocean
Currituck Sound
Pasquotank River
Perquimans River
Little River
Big Flatty Creek
Yeopim River
and Creek
Chowan River
Edenton Bay
Albemarle Sound
1
2
3
4
5
6
10 0 10 Kilometers

2.608
9.519
4.135
5.382
0.397
19.628

Quantitative SAV Surveys 1958 – 1964 Cooperative Studies

- Bureau of Sport Fisheries and Wildlife (USFWS)
- North Carolina Wildlife Resources Commission
- Virginia Commission of Game and Inland Fisheries

- Study Personnel
  - John L. Sincock, USFWS Chief Biologist/Coordinator
  - K.H. Johnson, NCWRC Fisheries Biologist
  - J.L. Coggin – Virginia CGIF Game Biologist
  - Wollitz, Kerwin, Dickson, Crowell, Grandy, Davis, McCartney

Back Bay – Currituck Sound Study 1958 – 1964 Objectives

- Identify primary physical, chemical and biological factors responsible for reduction in waterfowl use
- Determine procedures for increasing waterfowl use while retaining and improving fisheries values
- Determine feasibility of applying study procedures on an operational basis
- Provide basic data for reinterpretation and the historical record, “ very rough, incomplete first-draft”

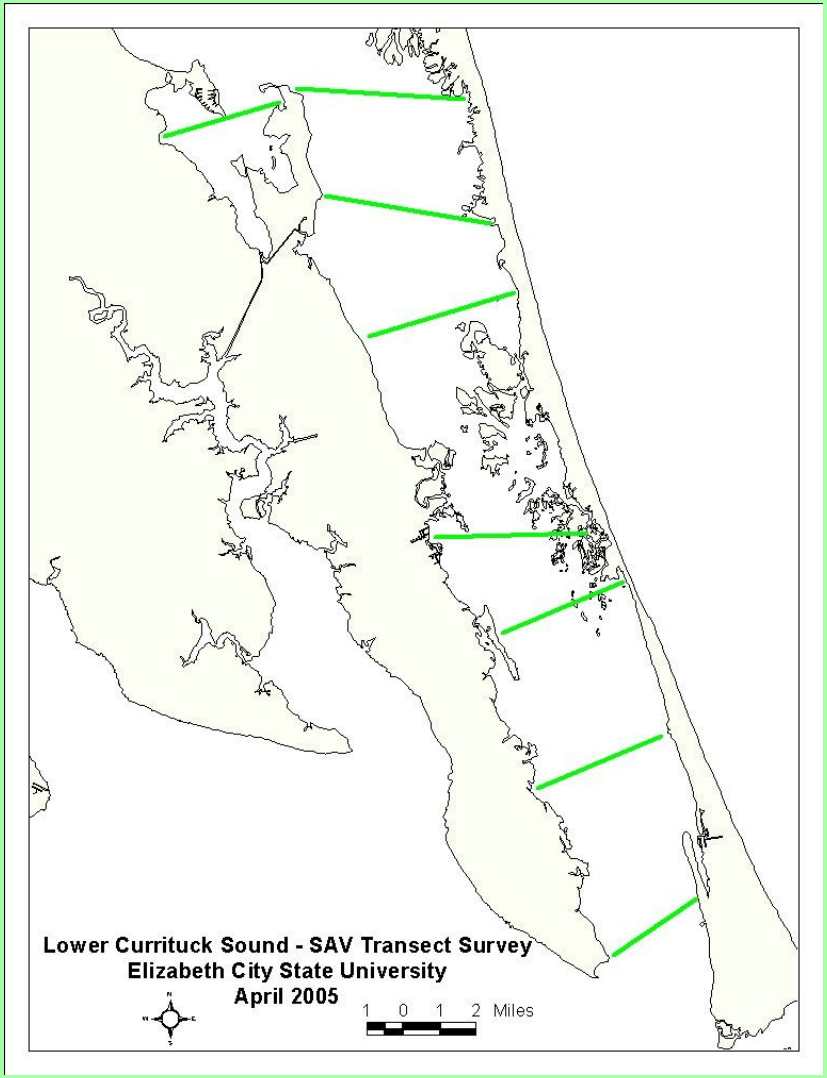
Back Bay – Currituck Sound Study 1958 – 1964

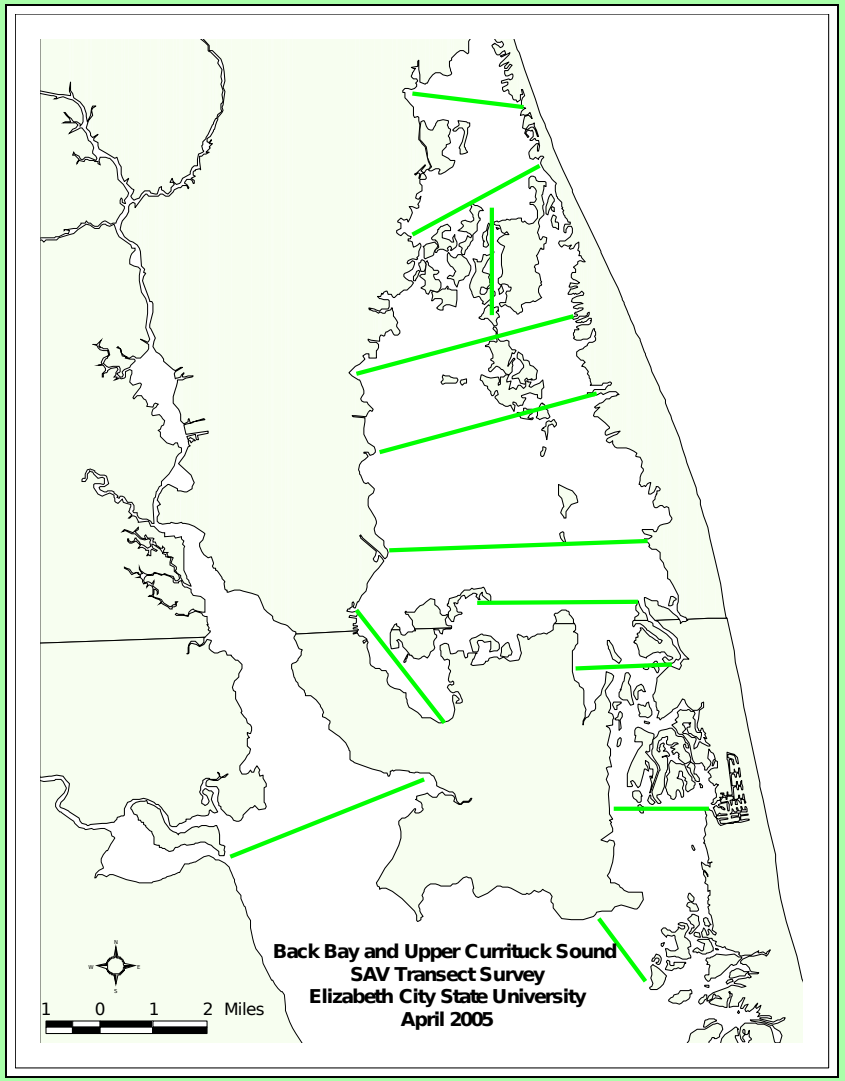
- May 1958 – January 1962
  - Fresh to slightly brackish water conditions
- March 7, 1962 “Ash Wednesday” Storm
  - Ocean water crosses barrier islands
  - Salinity increased to 13 % of sea strength
  - Level of salinity being considered for management
- Study continued through April 1964
  - “ … four years prior data, recommendation fulfilled by natural events, follow up on results””

Quantitative SAV Surveys 1958 – 1964 Objectives and Methodology

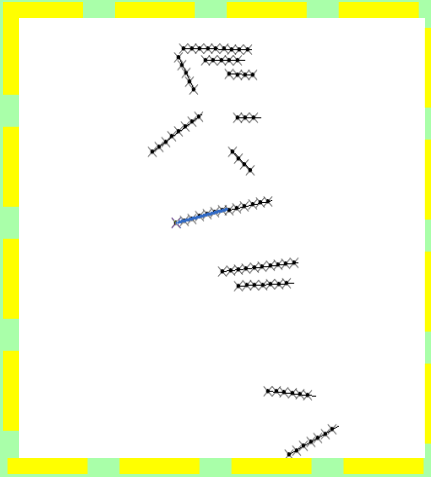
- Determine trends in kinds and amounts of aquatic vegetation throughout Back Bay and Currituck Sound
- Evaluation of the effects of ocean water intrusion (after “Ash Wednesday” storm)
- Systematic Sampling Design
  - 20 transects (23 transect surveys May ’58 – Nov ‘64)
  - February, May, August and November
  - Stations located every 500 yards

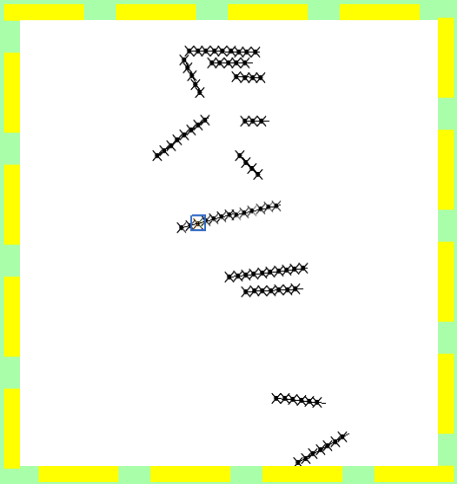
2005 Sincock SAV Transect Surveys





Spatial Technology Applications





First | < | > | Last | Delete

Line feature: Currituck_Sound_Transe

Attribute Name	Value
Id	0
Length	6,500.00000...
Line_ID	M

Summary | Attributes | 68% Precisions

Line Length (2D): 6.499 km
Line Length (3D): 6.499 km

Filename: eter_transect_points.imp
Status... Imported
Offset... <None>

First | < | > | Last | Delete

Point feature: 1000meter_transect_poi

Attribute Name	Value
Id	0
RefFID	17
StepID	3
X	880,897.25002100000
Y	299,744.63916100000

Summary | Attributes | 68% Precisions

Positions: 1
Std Deviation: ?

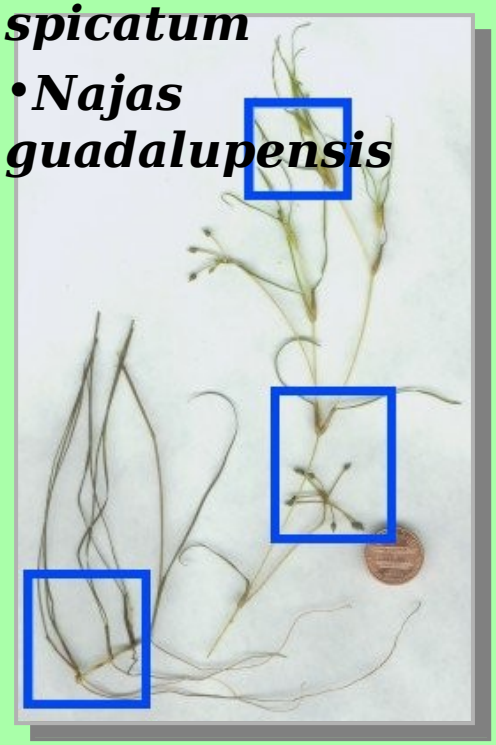
Filename: eter_transect_points.imp
Status... Imported
Offset... <None>

Quantitative SAV Surveys 1958 – 1964 Field Procedures

- Station every 500 meters – 20 transects (120 km)
- At each station
  - Three samples of the bottom
  - Two square feet (1,368 ft^2)
  - Oyster tongs (sample underground biomass, roots, rhizomes)
- Each sample recorded and measured separately
  - Sediments removed
  - “ocular estimates” – percent species composition
  - Volumetric measurements (water displacement index of true volume
- Water column parameters
  - Depth, secchi disc, turbidity, bottom type
  - Water samples for chemical analysis

Common Submersed Rooted Vascular Plant Species

- ***Ruppia maritima***
- ***Vallisneria americana***
- ***Potamogeton perfoliatus***
- ***Myriophyllum spicatum***
- ***Najas guadalupensis***



Complex algal species also present

Chara spp.

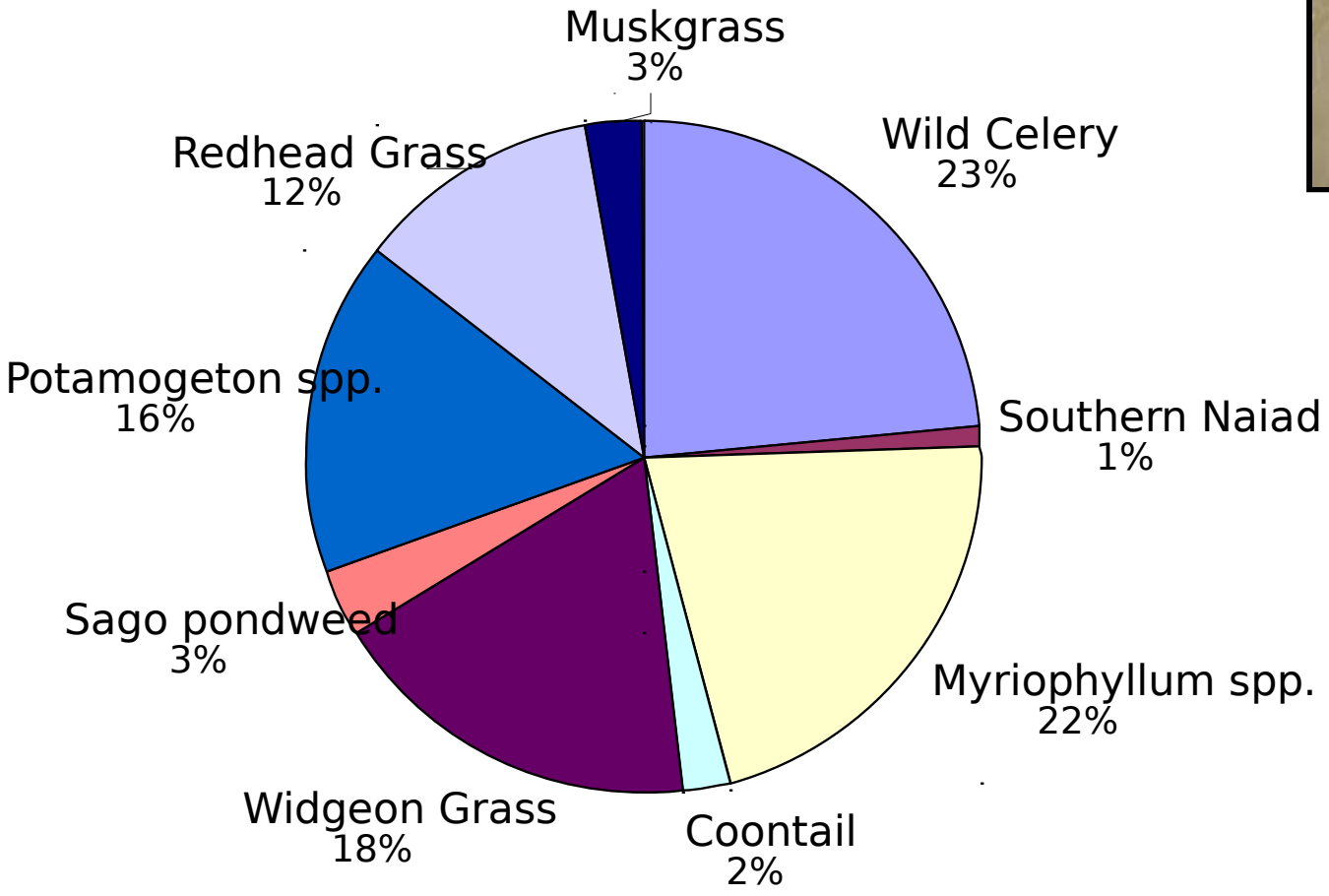
Wild Celery (*Vallisneria americana*) and

RedheadGrass (*Potamogeton perfoliatus*)

Wild Celery (*Vallisneria americana*) and

Widgeon Grass (*Ruppia maritima*)

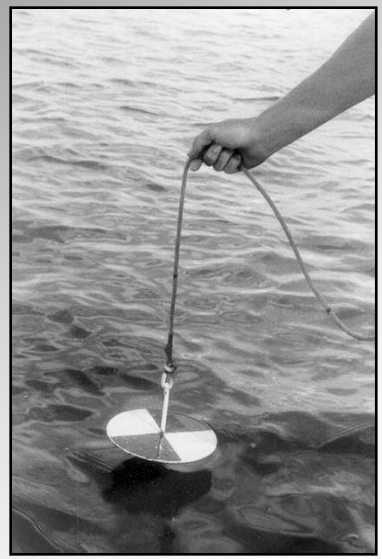
ubmerged Aquatic Vegetatio

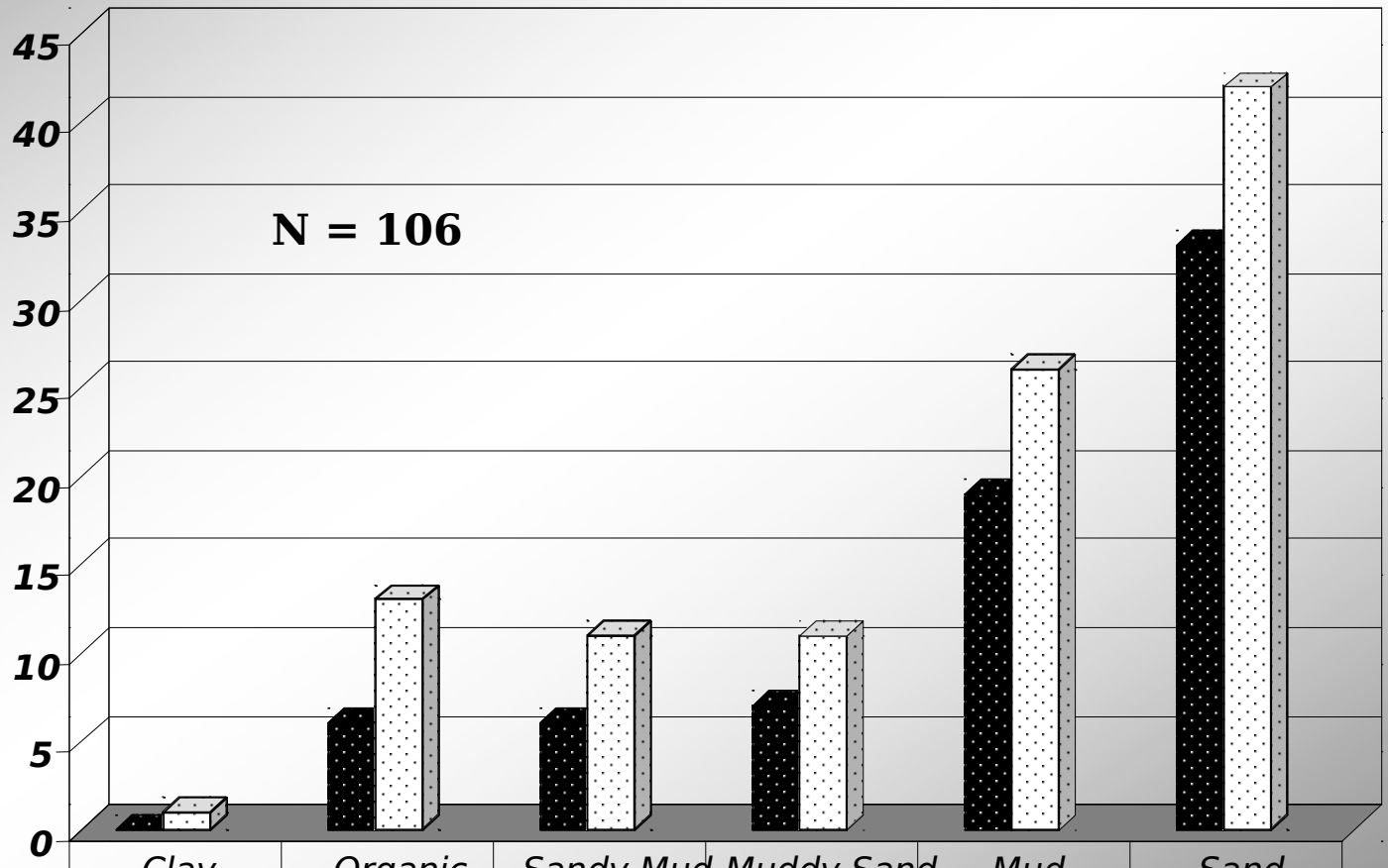


N=106

- **Wild Celery**
- Southern Naiad
- **Myriophyllum spp.**
- Coontail
- **Widgeon Grass**
- Sago pondweed
- **Potamogeton spp.**
- **Redhead Grass**
- Muskgrass

Occurrences of SAV by Bottom Type





	Clay	Organic	Sandy Mud	Muddy Sand	Mud	Sand
Occurrences of SAV	0	6	6	7	19	33
# of Samples per Bottom Type	1	13	11	11	26	42
Percentage of Occurrence	0%	46%	55%	64%	73%	79%

Currituck Sound Bush Duck Blinds